DEPARTMENT OF AGRICULTURE SERVICE National Forest San Bernardino, CA 92508-34
(909) 383-5616 TEXT TDD

Reply To: 3420 Date: July 13, 1994

Subject: Management of bark beetle caused mortality following the Devil Fire (FPM Report No. S94-4)

To: Forest Supervisor, San Bernardino National Forest

On July 10, 1994, Katie Clifford and I examined pinyon pine and Jeffrey pine stands in and around the Devil Fire. The Devil Fire began July 3, 1994, and burned approximately 12,000 acres of primarily pinyon (Pinus monophylla) woodland, but also some mixed stands including Jeffrey pine, Joshua tree, juniper, oak, and chapparal. There were a few unburned fingers of forest extending in from the perimeter, particularly along forest road 3N14 in sections 14 and 23 (T.3 N., R.2 W.) In addition, some islands of vegetation within the perimeter survived. Most of the latter were brush, but one notable exception were pinyon pines at Horse Spring Campground.

The area we visited was along 3N14 from Fawnskin to Rattlesnake Spring, in addition to the detour to Horse Spring. We examined pinyon mortality outside the fire area (up to and including Little Pine Flat) to assess the potential for insect problems on fire stressed trees.

In areas unaffected by the fire, recent pinyon mortality was readily visible at levels of up to a few trees per acre. This amount of mortality would not normally be a cause for concern except that it indicates an active population of bark beetles, primarily Ips confusus (a five-spined pinyon Ips). We also found Dendroctonus valens (the red turpentine beetle) attacking pinyon in the area, as well as pitch masses indicative of Dioryctria sp. (a small pyralid moth which is primarily a cosmetic pest), and dwarf mistletoe. Some mortality could have been primarily caused by black stain root disease, but we lacked the time to adequately survey for this pathogen, and its presence at low levels is not germaine to bark beetle outbreaks that may occur following this fire. Dendroctonus brevicomus, the western pine beetle, is also known to occur in the San Bernardino Mountains and sometimes attacks pinyons.

Low levels of Jeffrey pine mortality were also seen in areas unaffected by the fire. Most of this mortality was probably due to the Jeffrey pine beetle, D. jeffreyi. D. valens also attacks Jeffrey pine, but does not normally cause mortality. Ips pini, the pine engraver, also attacks Jeffrey pine.

Sometimes fires are followed by massive outbreaks of bark beetles which destroy the remaining stand, while at other times such outbreaks do not occur. Outbreaks cannot be predicted. The following factors facilitate an outbreak of bark beetles:

damaging species of bark beetles are already visibly present in the surrounding forest.

> Although badly burned trees do not have phloem in adequate condition to support bark beetle brood, scorched trees do have succulent phloem and are often too weakened to pitch out attacking bark beetles. Trees adjacent to a fire may also be stressed in less obvious ways, such as by sudden exposure caused by loss of adjacent trees. There are many scorched and stressed trees surrounding this fire, and these trees are ideal host material for bark beetles.

> Most of the bark beetles listed above (the Jeffrey pine beetle, which is univoltine, is the exception) have up to 5 or more generations a year in southern California where the weather is warm. Thus their populations can build up very rapidly.

> Initial attacks on fire damaged trees are likely to spill over onto adjacent undamaged trees. If the latter are attacked en masse, their defenses will be overcome even if they are otherwise healthy.

(The mass attack phenomenon in these bark beetles is mediated by volative pheromones. The pioneer beetles discover a suitable host tree, tunnel into the phloem, and release powerful attractants in their frass. Hundreds of beetles respond to these attractant pheromones, and some of the responders may land on adjacent trees, particularly if the attack has been underway long enough for the beetles on the initially-attacked tree to produce anti-aggregating pheromones. The latter signify that "this tree is full, go elsewhere." Spill-over attacks are responsible for "spot kills" of a few to several trees in a group.)

> Because of the amount of brood which could be produced in the many fire-damaged and adjacent healthy trees surrounding the Devil Fire, there is potential for a large bark beetle outbreak and associated tree mortality even in the absence of other stressors such as drought.

> Trees in the area surrounding the Devil Fire may be under drought stress. Rainfall in southern California in the 1993-94 season was well below average. Although rainfall in the previous three seasons was at or above average, trees may not yet have recovered from the previous drought.

> Other stressors such as dwarf mistletoe and root disease may be present in portions of the stand.

Management options

1. Do nothing. Under this option, it is possible and perhaps quite likely that outbreaks of bark beetles will occur, causing significant amounts of tree mortality. Further, pinyon is very difficult to regenerate, and previous attempts to revegetate fires in pinyon in the Forest have been mostly unsuccessful (see report by Katie Clifford). Thus it is likely that under this option, even larger areas would be denuded for decades. Previous fires in pinyon in this area have been followed by bark beetle outbreaks (K.Clifford, pers. comm.)

Direct control. Under this option, if bark beetles were seen to attack trees, the trees could be felled and treated mechanically or chemically to kill the beetles. This method has never been shown to be effective in preventing subsequent tree mortality. With the large acreages surrounding the Devil Fire and the presence of beetles with multiple generations each year, it would not be humanly possible to locate and fell all the attacked trees before the new brood emerged.

3. Salvage and removal of fire damaged trees. Prompt (e.g., within a few weeks) removal of the fire damaged trees and adjacent trees under spill-over bark beetle attacks would remove the most easily attacked food source. Because of the area involved, it may be impossible to remove this material before it is attacked and the new brood develops and emerges. However, high priority areas could be treated. If the material cannot be removed before it is attacked, spill-over attacks would occur and could be difficult to detect. Since the objective would be to prevent massive buildup of bark beetles, trees with spill-over attacks would have to be found and removed. In addition, all slash created must be disposed of promptly to prevent buildup of engraver beetles.

4. Preventative pesticide application to undamaged trees. Spraying the boles of healthy trees around a fire is a proven method of preventing bark beetle caused mortality. On the San Bernardino this method was used following the Panorama Fire and was very successful (mortality did not occur among the sprayed trees). Preventative spraying is currently used in R-5 on rust resistant sugar pine trees. This method is often only recommended for high value trees, such as those in campgrounds, because of associated costs: personnel, equipment and materials can cost $10-20 per tree.

The above options might be used in combination with each other. For example, preventative spraying may be the method of choice in Horse Spring Campground, while salvage in other accessible areas might be more economically feasible. It is important that any slash created be disposed of promptly. Chipping would prevent bark beetle infestation in slash, remove the standing fuel, and, if the chips were scattered in place, reduce erosion during runoff. Some areas may be too inaccessible for either treatment, and pockets of bark beetle mortality may consequently occur.

The most likely bark beetle to create problems in pinyon is I. confusus. This is not an aggressive bark beetle and normally only attacks trees weakened by drought, disease, or defoliation by other pests. Thus it would be reasonable to expect bark beetle mortality after the fire to be limited to one or two years of attacks.

The catastrophic losses in this fire have raised the issue of thinning pinyon as a method of reducing susceptibility to fire. From the perspective of pest damage, such thinning should result in a more vigorous, bark beetle-resistant stand, particularly if the thinning were combined with dwarf mistletoe suppression. However, there is evidence in other conifer species that thinning may cause the initiation of new black stain root disease centers. For further discussion of this issue and black stain root disease in pinyon, please see FPM Report R92-01, "Biological evaluation of pinyon pine mortality, Chimney Peak Area, Bureau of Land Management," written by L. Merrill, J. Pronos, and J.L.

nuary 1992, Forest Pest Management, Pacific Southwest Region, 16 pp. upply copies of this document on request.

Please notify me if I can be of further assistance on these issues.

Laura D Merrill

Laura Merrill, Entomologist
Forest Pest Management
Southern California Shared Service Area

cc: Program Leader, Forest Pest Management, R-5
District Rangers, Arrowhead and Big Bear Ranger Districts